(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 118 273 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.01.2017 Bulletin 2017/03

(51) Int Cl.:
C09D 133/06 *(2006.01)* ***C08L 33/06*** *(2006.01)*

(21) Application number: **16172860.5**

(22) Date of filing: **03.06.2016**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **03.06.2015 IT UB20151058**

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(54) **MULTILAYER MATERIAL USABLE PARTICULARLY AS DAMPING MATERIAL**

(57) A multilayer material is described, comprising a first layer having a modulus of elasticity between 70 and 150 N/mm^2 coupled to a second layer comprising a reticulated viscoelastic material comprising at least one acrylic resin. The modulus of elasticity of said material is preferably between $1*10^7$ N/m^2 and $1.80*10^9$ N/m^2 and the acrylic resin is present in the viscoelastic material in percentage by weight between 25 and 50%. The multilayer material of the present invention is preferably used as damping material.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a multilayer material usable particularly as damping material.

STATE OF THE ART

[0002] It is known to use double-layer materials as damping materials, particularly, in the manufacturing fields of automobiles, transport means, commercial and industrial vehicles in general, small and large household appliances and in the railway and construction field.

[0003] In the field of motor vehicles, transport means and commercial and industrial vehicles, the damping materials are used to mitigate and eliminate the noise generated by the vibration of the metal sheets with which the vehicle body is made. For this purpose, the damping material is applied solidly and permanently to the metal sheet.

[0004] It is known, for example, to use damping materials formed by a bitumen based layer co-laminated with a thin metal layer.

[0005] Traditional damping materials comprising a bituminous substrate, however, are not very malleable and moldable and are not easy to apply, especially on metal sheets with ribs and bosses. For being applied the damping material must then be preheated in order to be softened.

[0006] Also known to be used as a damping material is a non-reticulated butyl rubber layer, coupled to a metal layer to form sheets, from which appropriate lengths are cut out for the various applications.

[0007] The butyl however, is very sticky and comes leaks from the pre-cut edges of the sheets due to the pressure exerted on the sheet of damping material during the die-cutting and during the transportation step which is due to the weight of the various overlapping materials.

[0008] It is therefore necessary to use an additional layer of material such as a liner or similar removable protective films which extend well beyond the shape of the damping material to avoid this problem.

[0009] Furthermore, when the butyl is coupled with a metal layer to form a double-layer, the obtained damping materials must be packed in small sized containers, for the same reason in that the butyl would leak from the materials once subjected to pressure. Said containers, however, require handling and disposal.

[0010] Furthermore, the double-layer damping material covered with the covering liner is not as easy to handle.

[0011] A further problem of all known damping materials is the fact that they are very heavy, while car manufacturers continually require lighter products so as to also achieve savings in fuel.

[0012] Furthermore, new damping materials having high damping properties are under constant research.

SUMMARY OF THE INVENTION

[0013] The object of the present invention is to provide an acoustic damper which solves all the above mentioned problems and which, particularly, has improved damping properties and is lighter.

[0014] According to the present invention the above object is achieved by a multilayer material according to claim 1.

DESCRIPTION OF THE INVENTION

[0015] In the context of the present invention, the term layer means a mass of homogeneous material lying more or less evenly over a surface.

[0016] In the context of the present invention, the term "coupled" refers to the fact that a layer is "in direct contact" with the nearest layer and is inseparable therefrom. To couple two layers various methods are possible such as coating, and spraying.

[0017] In the context of the present invention, the term "density" of the multilayer material means the measured total density of the finished product.

[0018] According to the present invention, a multi-layer material comprising a first layer having a modulus of elasticity between 70 and 150 N/mm^2 is provided, coupled to a second layer comprising a reticulated viscoelastic material comprising at least one acrylic resin.

[0019] The first layer preferably consists of a metal layer being, even more preferably, aluminum.

[0020] The thickness of the first layer is preferably between 20 and 500 μm, more preferably between 50 and 300 μm, and most preferably between 75 and 200 μm.

[0021] The second layer comprises a reticulated viscoelastic material preferably comprising an acrylic resin. Preferably the thickness of the second layer is between 1 and 3 mm.

[0022] Preferably, the multilayer material has a composite loss factor greater than 0.44 at 20°C for a weight of 2 kg

per square meter.

[0023] Preferably the viscoelastic material has a modulus of elasticity between $1*10^7$ and $1.80*10^9$ N/m^2.

[0024] Preferably the acrylic resin is present in the viscoelastic material in % by weight between 25 and 50% of the weight of the reticulated material.

[0025] Preferably acrylic resins used are, with a vitreous transition temperature (Tg) in the temperature range from +10°C to -35°C.

[0026] Preferably the double-layer material obtained by the coupling between the first and the second layer has a total density of less than 1200 kg/m^3.

[0027] More preferably, the multilayer material has a density between 900 and 1100 kg/m^3.

[0028] Preferably the viscoelastic material in addition to the acrylic resin further comprises a resin chosen from the group consisting of colophony, coumarone-indene or mixtures thereof.

[0029] Preferably the reticulated viscoelastic material is in the form of solid resin in the finished product, and comprises fillers within percentages between 50 and 75% by weight with respect to the weight of the solid resin.

[0030] Preferably, the multilayer material comprises a filler chosen from the group constituted by talcum, calcium carbonate, mica, graphite or mixtures thereof.

[0031] Preferably, the multilayer material comprises a filler magnetizable or permanently magnetically orientable.

[0032] Preferably, in this case the multilayer material comprises a filler chosen from the group consisting of barium hexaferrite, strontium hexaferrite or mixtures thereof.

[0033] Preferably the viscoelastic material further comprises an expander. More preferably the expander comprises microspheres with mean granulometry between 10 and 80 μm, even more preferably between 10 and 30 μm and an expansion temperature between 80°C and 120°C, more preferably between 80°C and 95°C.

[0034] Preferably the viscoelastic material further comprises a thixotropic thickener.

[0035] Preferably, the thixotropic thickener is an emulsion of a copolymer containing an acrylic resin.

[0036] For example, the thixotropic thickener can be ACRYSOL ASF 60 - Dow Chemicals or UNICRYL TH6 - Sarco Chemicals.

[0037] Preferably, the multilayer material further comprises a third layer in contact with the second layer. The third layer is preferably constituted by a transferable self-adhesive. Preferably the third layer has a weight ranging between 40 to 120 g/m^2.

[0038] Preferably, the multilayer material further comprises a fourth layer in contact with the third layer and the fourth layer is preferably a removable silicone film.

[0039] The multilayer material of the present invention is manufactured by first preparing the viscoelastic material in a mixer and then adding the acrylic resin in aqueous dispersion.

[0040] Preferably, the acrylic resins in aqueous dispersion are introduced in a turbo mixer. Subsequently and while being stirred, additives are added such as, purely by way of example, antifoams, dispersants, coalescing agents, etc. Then, while being stirred continually, all the powdered materials are added, comprising the expander. Mixing continues under a vacuum for about 10-15 minutes until the mixture is homogeneous and free from air bubbles.

[0041] Subsequently, while still under the vacuum, preferably a thixotropic thickener is added, then left to be mixed under vacuum and the viscoelastic compound is emptied into suitable containers.

[0042] In a subsequent step, the compound is preferably spread on the aluminum layer and subjected to heat for the complete reticulation of the acrylic resin.

[0043] The first layer is preferably coupled to the second layer by coating or spraying.

[0044] Finally, the damping material is preferably associated with a third and fourth layer formed by a coupled element made of a self-adhesive transfer film, protected by removable silicone film.

[0045] The resulting product can then be cut into sheets for subsequent template die-cutting with specific equipment.

[0046] For under-head applications a magnetization step is added, preferably on the material already reticulated.

[0047] The multilayer material is preferably used as acoustic damper.

[0048] As for traditional products, the damping materials, to which the present invention relates, can be supplied already sheared and cut according to the predefined dimensions required by specific applications for the car, such as leathers on the doors, on the under-seat metal sheet, on the wheel-well, on the spark arrester, under the roof panel, etc.

[0049] From an examination of the characteristics of the multilayer material, according to the present invention, the advantages that it obtains are apparent.

[0050] In particular, it is characteristic of the multilayer material according to the present invention, to have non-sticky edges, which do not require special protection and the use of the protective film is only limited to the component surface, allowing a reduction of the disposal volume of the protective liner. It is also possible, in this way, to save on the additional containers required by the double-layers utilizing butyl rubber.

[0051] Furthermore, with respect to traditional products formed by a bituminous coating, the product of the present invention is characterized by an extreme malleability and formability and is easily applicable also on metal sheets with ribs and bosses, without the need to be preheated, as is the case today, to make the bituminous substrate softer.

[0052] The product relating to the present invention, furthermore, overcomes all the negative limitations of the double-layers made from butyl rubber.

[0053] Some examples of damping material according to the present invention are shown in the following thereby the invention is not limited thereto.

EXAMPLES 1-3

[0054] In Table 1 three examples of viscoelastic material are shown, usable as a second layer to form a multilayer material according to the present invention.

Table 1

Components (% by weight)	1	2	3
Acrylic resin - ACRONAL 3612 - Tg -12 °C - BASF	30.0%	30.0%	20.0%
Acrylic resin - PRIMAL C.A 187 - Tg -27 °C - R.HAAS	20.0%	20.0%	
Acrylic resin - ACRONAL DS 3502 - Tg + 4 °C - BASF			30.0%
Antifoams TEGP ANT. D2315 - Evonik	0.2%	0.2%	0.2%
Dispersant OROTAN 4045 - Dow Chemicals	0.5%	0.5%	0.5%
Coalescent DOWANOL DPNB - Dow Chemicals	1.0%	1.0%	1.0%
Colophony Resin - COLOPHONY W - Costa Irados	2.0%	2.0%	2.0%
Mica 60 (40-60 micron) - Minerals	10.0%		10.0%
Black Pigment - Iron Oxide 81C - Rock Wood	0.3%		0.3%
Calcium carbonate - Omycarb 2 av - Omya	10.0%		20.0%
Calcium carbonate - Omycarb 40 av - Omya	25.0%		15.0%
Ferrite - Strontium Ferrite type 16 - Tridelta		45.3%	
Expanders: Expancel 031 DU 40 - AKZO NOBEL	0.3%	0.3%	0.3%
Thickener and thixotropic - ACRYSOL ASE 60 - Dow Chemicals	0.7%	0.7%	0.7%
	100%	100%	100%

[0055] The formulation 1 allows to obtain excellent results when coupled to an aluminum sheet of a thickness preferably of 100 μm, more preferably of 150 μm.

[0056] In the formulation 2 a magnetization step is added after reticulation to orient the hexaferrite crystals contained in the viscoelastic material.

[0057] This formulation is particularly suitable for under-head applications.

[0058] Said formulation 3 allows to obtain excellent results when coupled to an aluminum sheet of a thickness preferably of 100 μm, more preferably 150 μm, and particularly for working temperatures with maximum loss factor at 40°C.

Examples 4-6

[0059] In Table 2 two multilayer materials made according to the prior art are compared with a double-layer multilayer material according to the present invention.

[0060] For convenience in comparison a first soft_aluminum layer of 150 μm in thickness was used in all three examples.

Characteristic	Aluminum + bitumen	Aluminum + butyl	Aluminum 150 microns + Acrylic according to the formulation 1
Density kg/dm^3	1.8	1.7	1
Minimum Thickness [mm]	1.7	1.3	1.5
Minimum Weight Kg/m^2	3	2.2	1.5

(continued)

Characteristic	Aluminum + bitumen	Aluminum + butyl	Aluminum 150 microns + Acrylic according to the formulation 1
Composite loss factor (on sheet 0.8 mm) according to ASTM E 756	3 kg/m^2	2.2 kg/m^2	2 kg/m^2
10°C	0.25	0.26	0.30
20°C	0.28	0.30	0.44
30°C	0.24	0.26	0.30

[0061] As is evident from the results shown in Table 2, the composite loss factor obtained by using a multilayer material according to the present invention is better than that obtained from the multilayer materials according to the prior art. Simultaneously, the multilayer material according to the present invention, however, is also much lighter thus meeting the needs of the producers, particularly of the automotive industries.

Claims

1. A multilayer material comprising a first layer having a modulus of elasticity between 70 and 150 N/mm^2 coupled to a second layer comprising a reticulated viscoelastic material comprising at least one acrylic resin, in that the modulus of elasticity of said viscoelastic material is between 1*10^7 N/m^2 and 1.80*10^9 N/m^2, in that said at least one acrylic resin is present in said viscoelastic material in percentage by weight between 25 and 50%, in that the vitreous transition temperature (Tg) of said at least one acrylic resin is in the temperature range from +10°C to -35°C, in that the density measured as total density between the first and second layer is lower than 1200 kg/m^3, in that it comprises a resin chosen from the group constituted by colophony, coumarone-indene or mixtures thereof and in that said reticulated viscoelastic material comprises fillers in percentage between 50 and 75% by weight with respect to the weight of the solid resin and in that it comprises a resin chosen from the group constituted by colophony, coumarone-indene or mixtures thereof.

2. The multilayer material according to any one of the preceding claims, **characterized in that** the total density is between 900 and 1100 kg/m^3.

3. The multilayer material according to any one of the preceding claims, **characterized in that** it comprises a filler chosen from the group constituted by talcum, calcium carbonate, mica, graphite or mixtures thereof.

4. The multilayer material according to any one of the preceding claims, **characterized in that** it comprises a magnetizable filler.

5. A multilayer material according to any one of the preceding claims, **characterized in that** it comprises a filler chosen from the group constituted by barium hexaferrite, strontium hexaferrite or mixtures thereof.

6. The multilayer material according to any one of the preceding claims, **characterized in that** it comprises an expander.

7. The multilayer material according to claim 6, **characterized in that** said expander comprises microspheres with mean granulometry between 10 and 80 μm and an expansion temperature between 80°C and 120°C.

8. The multilayer material according to any one of the preceding claims, **characterized in that** it comprises a thixotropic thickener.

9. The multilayer material according to claim 8, **characterized in that** said thixotropic thickener is an emulsion of a copolymer containing an acrylic resin.

10. The multilayer material according to any one of the preceding claims, **characterized in that** said first layer is a metal layer, in particular aluminum.

11. The multilayer material according to any one of the preceding claims, **characterized in that** the thickness of said first layer is between 50 to 300 μm.

12. The multilayer material according to any one of the preceding claims, characterized it comprises a third layer in contact with said second layer and in that said third layer is constituted by a transferable self-adhesive.

13. The multilayer material according to claim 12, **characterized in that** it comprises a fourth layer and **in that** said fourth layer is a removable silicone film.

14. A method for manufacturing a multilayer material according to any one of the preceding claims, **characterized in that** it comprises the steps of:

- preparing said viscoelastic material in a mixer adding acrylic resin in aqueous dispersion,
- coupling the first layer and the second layer
- reticulating the viscoelastic material.

15. Use of a material according to any one of the claims from 1 to 14 as acoustic damper.

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 2860

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 September 2016	Droghetti, Anna

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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